

THE Encyclopedia

AMERICANA

COMPLETE IN
THIRTY VOLUMES

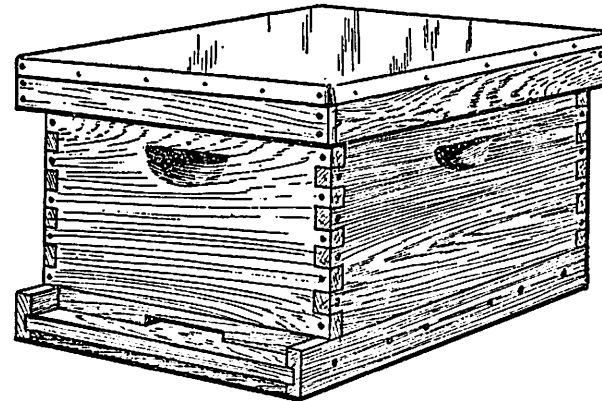
1829



1954

NEW YORK • CHICAGO • WASHINGTON, D.C.
AMERICANA CORPORATION

Diseases of Brood.—There are two diseases that attack the brood of honeybees; one is known as American, and the other as European foul brood. The American foul brood is the more serious, so serious that no cure can be safely applied. The bee-keeper who finds it in his hives should burn the combs, bees and all, and scorch out the inside of the hive with a blow torch before it is used again. The second disease known as European foul brood, can be cured by building up the strength of the colony, introducing a queen of vigorous, Italian strain. The building-up consists of giving frames of emerging brood so that the strength of the colony will be rapidly increased. For further particulars, send to the Bureau of Entomology, Bee Culture Laboratory, Washington, D.C. Treatment and cure will be described for both diseases, except that in the case of American foul brood, complete destruction of bees is recommended.



Modern hive of "Langstroth" dimensions.

Enemies of Bees.—A number of insects, birds, and mammals must be classed as enemies of bees, but of these the larger wax moth, the lesser wax moth, and ants are the only ones of importance. Moth larvae often destroy combs. To prevent this the combs are fumigated with paradichlorobenzene or bisulphide of carbon in tiers of hives or in tight rooms. In warm climates ants are a serious pest. The usual method of keeping them out is to put the hive on a stand, the legs of which rest in vessels containing oil or creosote.

BEE LARKSPUR. A well-known flowering plant, *Delphinium elatum*, having a flower resembling a bee.

BEE LOUSE (*Braulta coeca*), is a parasite on the honeybee, occurring on the thorax especially of the queen bee—rarely on the drones. Frank Benton, American apiculturist, states that he at one time removed as many as 75 from a queen, though the numbers do not generally exceed a dozen. The bee louse is about one-twentieth of an inch in length, entirely without wings, and somewhat spiderlike in appearance. On the day the maggot or larva hatches from the egg it sheds its skin and turns to an oval puparium of a dark-brown color. It has frequently been imported to the United States on queens with attendant bees but has gained no foothold.

BEE MARTIN, the kingbird, a flycatcher which occasionally eats bees. See KINGBIRD.

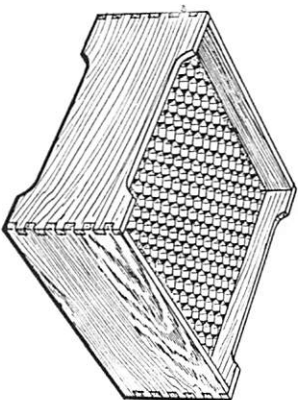
BEE MOTH, a moth belonging to the family Galleridae; specifically, *Galleria mellonella*, the larva of which feeds on wax in hives. The worm is yellowish-white with brownish dots. It constructs silken galleries running through the comb of the beehive on which it feeds. When about to transform it spins a thick white cocoon. Two broods of the moth appear, one in the spring, the other in August, and the caterpillars mature in about three weeks. It may become a most troublesome pest in the apiary.

BEE ORCHIS, the name of a species of orchis, the *Arachnites apifera*. It is so called because a part of the flower resembles a bee. It is large, with the sepals purplish or greenish-white, and the lip brown variegated with yellow.

BEE TREE, a forest tree inhabited by honey-making bees, which have taken possession of some natural hollow and filled it with combs. Such a tree may be found by accident, or by deliberate hunting. Those in search take to the edge of the woods a box of diluted honey, and when they see bees near them, open the bait to which one by one the bees will be attracted. The direction of their flight is then carefully observed; the bait is moved to another point.

wax, which is secreted by the bees and used by them for building their combs, is an important commercial product and commands a good price in the United States. Three to five million pounds are produced there annually. This wax is used for waterproofing, for sacramental candles, and in cosmetics. Frequently there are combs to be melted up, and it pays to take care even of scraps of comb and the cappings taken out in extracting. A common method of taking out the wax is to melt the combs in a glass-covered pan heated by the sun. Various wax presses are on the market, but if much wax is produced, it is advisable that the bee-keeper make a careful study of the methods of wax extraction as usually there is much wax wasted.

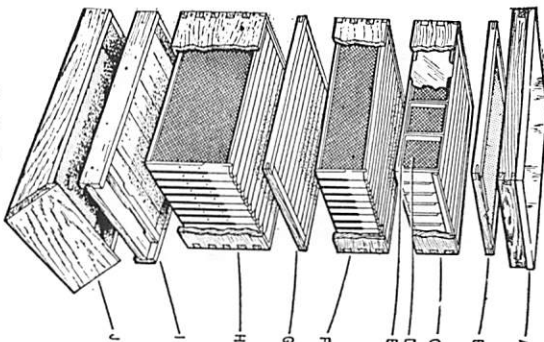
Comb Honey Production.—Comb honey is usually put up in little square boxes, of which several million are made and used in the United States annually. The honey in these boxes is in the liquid form, thrown from the combs by means of centrifugal force in a honey extractor, hence the name. Honey in the comb cannot be adulterated or manufactured, newspaper reports to the contrary. One bee-keeper of considerable standing and prominence has had a standing offer of \$1,000 for a single sample of artificial comb honey so perfect as to deceive the ordinary consumer. Notwithstanding that this offer has been broadly published over the United States for over 50 years, no one has ever claimed the reward. It may be well to explain that a partial basis for these newspaper reports lies in the fact that bee-keepers use a commercial product known as "comb foundation," which is sheeted wax embossed on both sides with indentations having the exact shape and form of the bottom of the cells of honeycomb—hence the name. It is put into the hive where the bees draw it out into comb. This is as far as the skill of man can go; hence there is no such thing as artificial comb honey.



Section containing full sheet of comb foundation.

Producing comb honey requires considerable skill. Hives and supers are so arranged that the little boxes containing strips of comb foundation shall be accessible to the bees where they can build the foundation into comb, fill the cells with honey and seal them over. When the bees are busy at work in the fields and the combs are beginning to whiten and to be bulged with honey in what is called the brood nest, the honey boxes are put in the upper part of the hive. These are allowed to remain on during the height of the

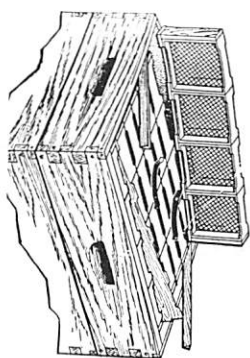
honey flow until they are filled and capped over, when they are removed and others put in their place.



See live for comb honey

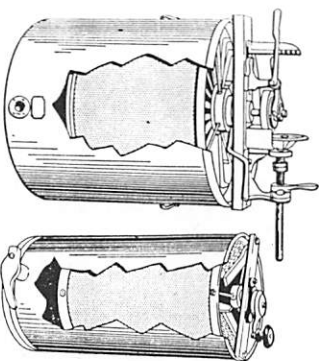
A—metal clad cover, telescopes over the supers below the brood nest, helps insulate bees from heat and cold. *B*—section super, for comb honey. *C*—section super, for liquid honey. *D*—supplies honey in the liquid form. *E*—comb section super. *F*—comb section super. *G*—excelsior board, with frames for storage of honey. *H*—excelsior board, with frames for storage of honey. *I*—excelsior board, with frames for storage of honey. *J*—excelsior board, with frames for storage of honey.

Extracted Honey Production.—The business of producing extracted (or liquid) honey requires almost the same intelligent care and attention. Instead of section boxes, however, an extra set of combs is put in the upper story, the same being placed above the lower or brood part of the hive. When these are filled with honey and capped over, they are removed from the hive by first shaking the bees off, or by what is known as a bee-escape board, taken to the extracting house and extracted. The thin film of wax covering the comb is shaved off with a knife specially designed for the purpose. After the combs are uncapped, they are put in the honey extractor, which is a high rate of speed. The honey flows out of the comb by centrifugal force against the sides of the extractor, when the combs are turned in a like manner. They are next returned to the hive to be filled by the bees, when the process may be repeated as long as the season lasts.



Beehive section super.

has reached a high state of prosperity and the combs are being filled with honey, a swarm may come forth between the hours of 9 a.m. and 3 p.m. Most of the bees, including the queen, are ready to come out with a rush, thousands of them being in the air. The bees hover about the entrance for two or three hours, or perhaps all day here for two or three hours, or perhaps all night, at the end of which time they will take wing again and go direct into some hollow tree or cave where they will take up new quarters and start housekeeping anew. The young bees, together with those unattached, with one or more young queens, are left to take care of the old hive.



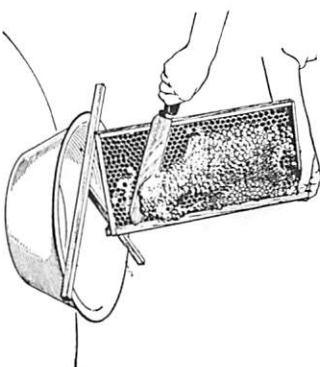
Honey extractors: left, power-operated; right, hand-operated.

In ordinary practice it is a custom for the bee-keeper to remove the swarm by taking the bees as soon as they cluster and putting them into another hive. Or, he may, if he chooses, ship the old queen's wings, preventing her flight with the swarm; and when the bees come forth they will crawl out of the entrance to be captured by her owner and as soon as her subjects return, they are allowed to go into a new hive on the old stand, while the old hive is carried to another location in the bee yard.

Prevention of Swarming.—Since crowded and overcast hives are conducive to swarming, this tendency is overcome by giving plenty of ventilation and additional room in the hive.

Swarming.—At the beginning of or during what is called the honey flow, when the colony

Shade is also a good preventive. Frequent examinations of the hive during the swarming season for the purpose of cutting out queen cells is a help, and requeening with young queens early in the season generally prevents swarming.



Bee-keeper removing cappings from a comb.

Robbing.—There are certain times during the season when no nectar is secreted by the flowers. It is during such periods as this that the bees will rob each other if they can. When sweets can be obtained in considerable quantity from a weak colony unable to defend itself, the bees are apt to become furious and their craze is not unlike that of gold miners when gold is discovered in large quantities. There is a rush and when the sweets are suddenly cut off, the bees are inclined to be cross and to sting. The wise and careful bee-keeper will see to it that the entrance of his weak colonies are properly protected so that the sentinels or guards can protect themselves from intrusion from other bees.

Feeding.—When bees are short of honey, sugar syrup may be substituted. This is fed to the bees in an inverted can with a few small holes punched in the lid. This is placed on top of the beehive. Feeding, at best, is a necessary evil. It is always better to give bees combs of honey or better yet, a whole hive body of combs containing honey. Sugar syrup—two parts sugar, one part water—is not a natural food and should be used only when no sweet is available from the field.

Transferring.—In increasing the apiary it is sometimes best to buy colonies in box hives on account of their smaller cost, and to transfer them to hives with movable frames. This should be done as soon as possible, for box-hive colonies are of small value as producers. The best time to transfer is in the spring, when the amount of honey and the population of the colony are at a minimum. Transferring need not be delayed until spring merely because that season is best for the work. It may be done at any time during the active season, but, whenever possible, during a honey flow, to prevent robbing.

Wintering.—During the winter it is often desirable to protect the hives with waterproof paper, with packing material between hive and paper in cold climates. The entrances should be contracted down to shut out as much cold as possible. In extremely cold climates the hives may be carried into a suitable cellar.

apparently causes one individual to emerge from a cell and another to emerge from a cell in the egg stage the preadult stage, queen, and male is respectively 17, 21, and 24 days. The adult life of the period of active nectar flow is six weeks; during the much more favorable conditions it is six months or more.



of a comb of *Apis mellifica*, with some of them capped, others open) and the royal cell. Natural size.

tolerated in the hive until the queen is sharply dwindled. Then the queen is what is often referred to as the drone. It usually represents a frustration of their subsequence. As the drones are on the workers for food, expatriation home is the equivalent death.

of its development a *mellifica* needs 70,000 bees. New hives are swarming. The old queen departs, and her successor in the hive (provided there is no afterswarm) is the exodus of the swarm. To the princess often slays her royal sisters still imprisoned in their cells and stinging them. Taking experiments performed by the beekeeper have established that red and orange are distinguishable to honeybees, that blue and green are not, and that blue-green they recognize as blue and yellow. Finally they see the invisible to man.

o established the fact that a

has confirmed that honeybees are able to orient themselves by the polarization of sky light.

Interesting as are the discoveries made thus far regarding bees, it is safe to predict that much of a rewarding character still awaits the enterprising student of their ways.

Bibliography.—Sladen, F. W. L., *The Humble-Bee* (London, 1912); Franklin, Henry James, "The Bombardier of the New World," *Transactions of American Entomological Society*, vol. 38, Feb. 4, 1912, and vol. 39, July 17, 1913; Fabre, Jean Henri, *Bramble-Bees and Others* (New York 1915), and *The Mason-Bees* (New York 1916); Phillips, Everett Franklin, *Beekeeping* (New York 1918, rev. 1928); Lutz, Frank Eugene, "Apparently Non-Selective Characters and Combinations of Characters. Including a Study of Ultraviolet in Relation to Flower-Visiting Habits of Insects," *Annals of the New York Academy of Sciences*, vol. 29 (1924); Snodgrass, Robert Evans, *Anatomy and Physiology of the Honeybee* (New York 1925); Lutz, Frank Eugene, "Experiments with 'Stingless Bees' concerning Their Ability to Distinguish Ultra-Violet Patterns," *American Museum Novitates*, No. 641, 1933; Plath, Otto Emil, *Bumblebees and Their Ways* (New York 1934); Mitchell, Theodore Bertis, "A Revision of the Genus *Megachile* in the Nearctic Region," *Transactions of American Entomological Society*, vol. 59, Jan. 22, 1934, and vol. 61, April 1, 1935; Raymont, Tarlton, *A Cluster of Bees* (Sydney, Australia 1935); Cockerell, Theodore Dru Alison, *African Ceratina, Halictus, and Megachile* (London 1937); Ransome, Hilda M., *The Sacred Bee* (Boston and New York 1937); Sandhouse, Grace Adelbert, *The North American Bees of the Genus Osmia* (Washington 1939); Teale, Edwin Way, *The Golden Throng* (New York 1940); Michener, Charles Duncan, "Comparative External Morphology, Phylogeny, and a Classification of the Bees (Hymenoptera)," *Bulletin of American Museum of Natural History*, vol. 82, art. 6, April 10, 1944; Schwarz, Herbert F., "Stingless Bees (Meliponidae) of the Western Hemisphere," *Bulletin of American Museum of Natural History*, vol. 90, Feb. 16, 1948; Frisch, Karl von, *Bees, Their Vision, Chemical Senses, and Language* (Ithaca 1950).

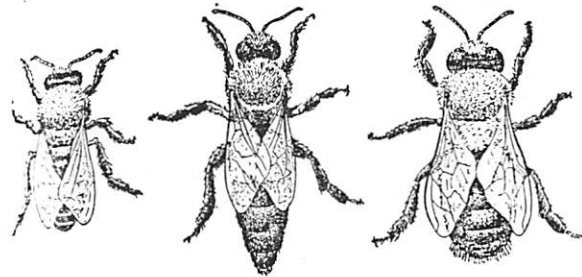
HERBERT F. SCHWARZ,

Research Associate, American Museum of Natural History.

BEE BIRDS, birds reputed to devour bees, especially the honeybee. Not many birds have this habit, the bees being protected against most birds by their stings. A few flycatching birds, however, have learned how to avoid being stung, and catch not only bees but wasps, take them to a perch and beat them, so as to kill them, and probably get rid of the sting before swallowing them. Notable among these are the European and African bee eaters (q.v.). The American kingbirds (q.v.) also catch bees, but not as frequently as is popularly supposed, and are known in the Southern states as bee martins.

BEE EATER, a small, richly plumaged and graceful bird of southern Europe and northern Africa, whose food consists almost entirely of bees.

ange and mountain sage; in the North Central Eastern states, white, alsike, the new Ladino, sweet clover; in the South and West, orange, clo, palmetto, cats-claw, mesquite, and gua-



Left to right: worker; queen bee; drone.

Most authorities agree that the honeybees' value lies in their ability to cross-pollinate fruit and legume blossoms, and thus largely increase the production of fruit and seed. Bees are responsible for 80-85 per cent of all crop pollination performed by insects. With the increased use of insecticides and more intensive cultivation of the land, many wild insects have been destroyed in recent years, leaving the important work of pollination more and more to the honeybees.

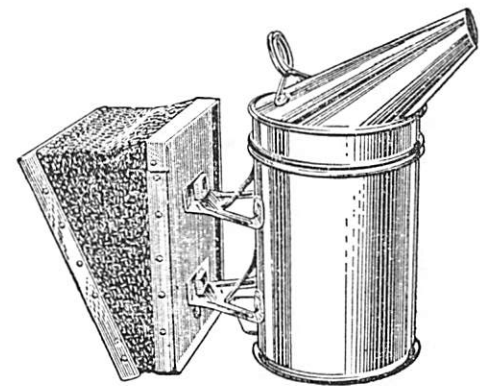
To assist in pollination and to increase the number of colonies, bees are shipped by the rail and from the South. In 1948 more than a million pounds of bees were shipped in two- and three-pound cages without combs.

There are several species of bees—*Apis dorsata*, or the giant bee of India and the Philippines; *A. indica*, of India; *A. florea*, and *A. mellifica*. From a commercial standpoint, the last mentioned is the most important. It comprises the black bee of this country; the Italian bee from the southern part of Italy; the Syrian bee of Palestine; the Cyprian, from the island of Cyprus; the Carniolan, from Austria, and the Caucasian from the Caucasus Mountains. But the most important of all these varieties is the Italian bee. They are the most industrious and the gentlest. They, together with the black bees and their crosses, incorrectly termed "hybrids," are used most extensively in the United States—indeed, throughout much of the civilized world.



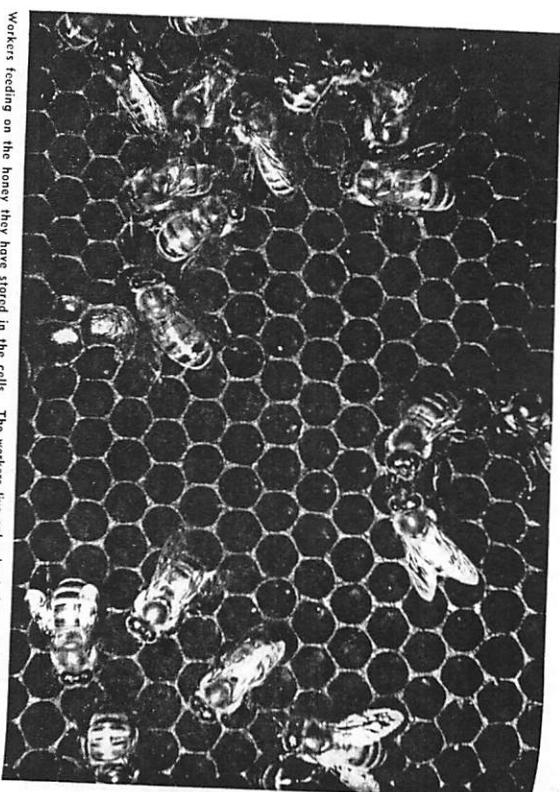
mother of the whole colony. The drones are incapable of gathering honey, and serve only one purpose—that of fertilizing or fecundating the young queens, which act takes place in the air. The workers gather all the honey and pollen, fill all the combs, and rear the young or baby bees. As soon as the mating season is over, the drones are allowed to starve.

How to Handle Bees.—There is a general impression that ordinary honeybees are vicious, ready to attack any one who comes near their hives. This is a great mistake. Under certain conditions, when their habits are known, they will permit one to tear their hives apart, rob them of their hard earnings—honey and the wax—without even offering to sting. But an inexperienced or awkward person may irritate them. To bring them into a state of subjection it is only necessary to blow smoke into the entrance and over the combs, at which time, if the motions about the hive are careful and deliberate, they will offer no attack. Smoke, when intelligently used, disarms opposition and puts the bees in a quiet state.



Bee-smoker.

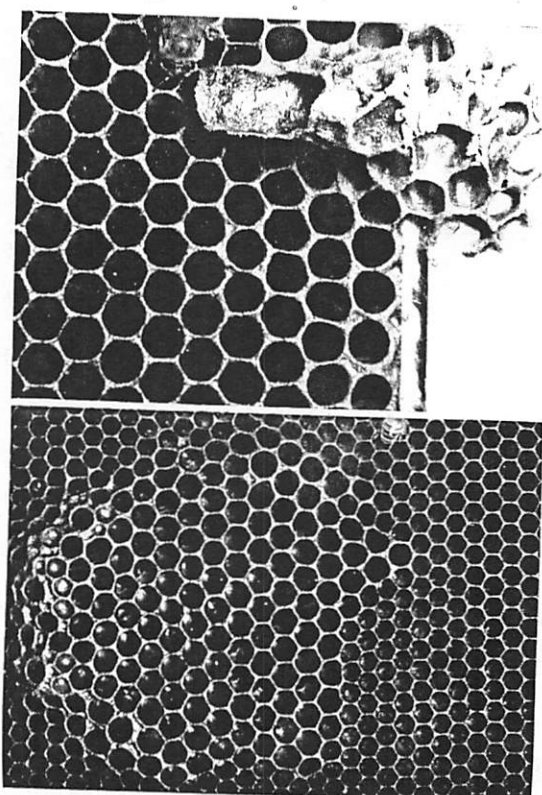
The bee-smoker is simply a small bellows attached to a cylindrical stove having a nozzle from which the smoke is blown. Besides the bee-smoker, the bee-keeper generally uses a bee-veil made of wire cloth. Gloves are sometimes used by timid persons or beginners, but as a general thing all work with the bees is performed with bare hands. Stings are, of course, occasionally received but beyond a sharp, momentary pain, no permanent effect will be felt after the first season for the bee-keeper very soon becomes immune so that no swelling takes place.



Workers feeding on the honey they have stored in the cells. The workers live only about six weeks in the warm season, possibly several months in the winter cluster.

© Bernard L. Clark

Lower left: The queen, or fertile female, is longer and larger than the workers. The cell containing an egg designated to become a queen is larger and irregularly shaped, and the surrounding cells built to house worker larvae.



that had conspicuous entrances. There is even a genus of bumblebees, *Psalithyrus*, that, like the solitary bees discussed in a previous paragraph, is dependent on a host species for the rearing of its young. In the case of *Psalithyrus* the host species is always a bumblebee. *Psalithyrus* has no worker caste and it is the workers of the usurped colony that rear the brood of the invader.

Stingless Bees (Meliponidae).—These bees form a large group of mainly tropical distribution in the Old World as well as the New. In pre-Columbian days, before the introduction of sugarcane and before the establishment in the Western Hemisphere of the Old World honeybee, the stingless bees were the main reliance of those craving sweets. Columbus made acquaintance with the honey of these bees when, anchoring Yucatan to this day there are flourishing apiaries of *Melipona beccarii*.

The sting of these bees is atrophied and non-functional but they have other means of defense. Some resort to biting. *Trigona* (*Oxytrigona*) emits a caustic fluid that is highly irritating—a form of chemical warfare long antedating such warfare by man. What often makes stingless bees annoying to human beings is their propensity to penetrate the hair. In Brazil they are called *torce cabedlos* (hair twisters) in consequence. A name applied in Brazil to some of the tiny bees of *Trigona* (*Hypotrignona*) is *lanbe abiss* (eye flickers) because of their habit of lapping moisture from the eye. Some stingless bees render powerless insect enemies that intrude in the nest by dabbing them with sticky material—perhaps honey—until they are pined to death. This, curiously enough, is a method of warfare practiced also by a bumblebee (*Bombus fervidus*).

Stingless bees stock the brood cells with food and after an egg has been laid seal the cell after the manner of the solitary bees instead of engaging in progressive feeding of the larva as do the honeybees and bumblebees. Some stingless bees arrange their brood cells in irregular clusters by minute intervening pillars of wax. The vast majority, however, arrange the cells in combs. These combs usually lie horizontally one above the other, not vertically as in the case of the honeybee, and the comb consists of a double layer of cells facing upward instead of a single layer of cells placed base to base as in colonies of *Apis mellifica*. Honey and pollen are stored by stingless bees not in the cells of a comb but in relatively large pots. Earthen materials, dung, resin, leaf particles, and the like are used in nest-building besides the wax the bees secrete. Some species are ground-nesting, others arboreal. Sometimes the nests are exposed but more often concealed in hollows, frequently with a projecting tube, spout, or trumpet-shaped formation advertising the presence of the nest. Some species erect their structures within the nests of termites. Others occupy the nests of ants; nests of *Aphaenogaster* are particularly favored. A few instances are recorded of the use of birds' nests as places of abode.

Edmond Drory, who in the 1870's tried to acclimatize stingless bees in Bordeaux, asserted that the male not only produced wax like the worker but also performed other tasks. These claims require verification notwithstanding the conscientious source from which they come.

Throughout the Apidae the role of the male tends to be limited to the fertilization of the female.



FIG. 8.—Rock painting at the Arana (Spider) Cave, north-west of Ilo-Lo, Valencia, Spain, showing an individual bee. Above are gathering honey from a well defended hive. About half actual size.

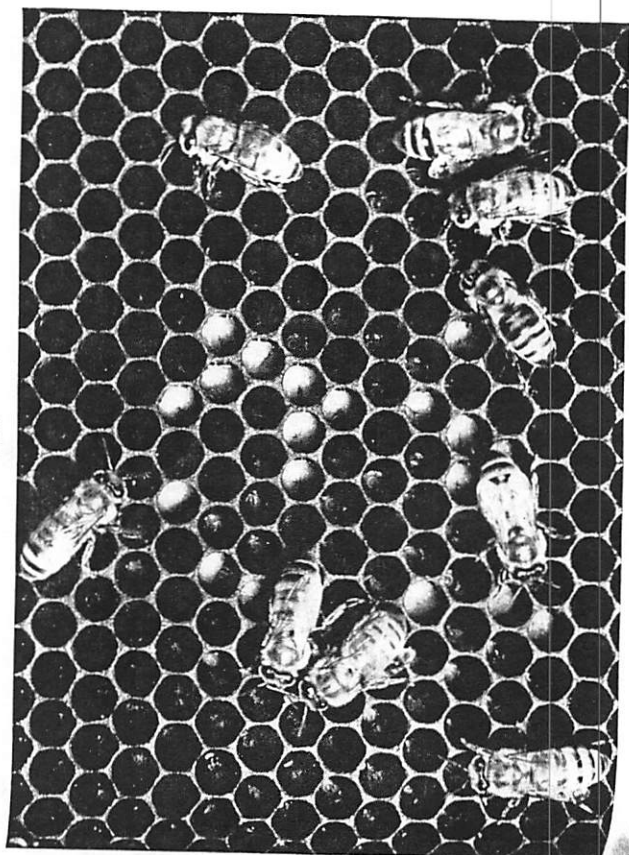
A relief in the Temple of the Sun, built about 2600 B.C., indicates that at that remote date beekeeping was practiced by the Egyptians. Techniques of apiculture which are sometimes thought of as modern—for instance, the transfer of hives from one region to another to take advantage of the nectar flow—were known in the Nile region as long ago as the 3d century B.C.

Apis mellifica has been introduced to many regions of the Western Hemisphere but originally it was a stranger to that half of the globe. It reached New England through the agency of man in the first part of the 17th century.

Several members of the genus *Apis* occur in the Indo-Malayan region. In addition to *Apis indica*, very closely allied to *mellifica*, there are the giant honeybee (*Apis dorsata*) and the dwarf honeybee (*Apis florea*). In the huge semicircular comb of *dorsata*, sometimes three or four feet in diameter and suspended usually from the branch of a tree, the brood cells are of one size. This uniformity accords with the condition in nests of the stingless bee genus *Melipona*. On the other hand *florea* builds like *mellifica*, brood cells of three different kinds, dependent on the sex and prospective caste of the occupant.

The honeybee queen makes in high. A single copulation usually enables the queen to lay fertile eggs throughout her subsequent life of several years. Her egg-laying capacity is impressive, varying from a few eggs daily in early spring and late fall in the northern part of her range, to as many as 1,500 to 2,000 per day at the peak of oviposition. Under special conditions even up to 5,000 eggs a day may be laid. Unfertilized eggs give rise to males.

All larvae are nourished for the first two or three days with royal jelly, probably a secretion of the lateral pharyngeal glands of the worker. At the end of this period honey and pollen are substituted as the diet of the prospective workers and drones, but royal jelly continues to be the food of a larva reared to be a queen. This difference of diet rather than any difference in the

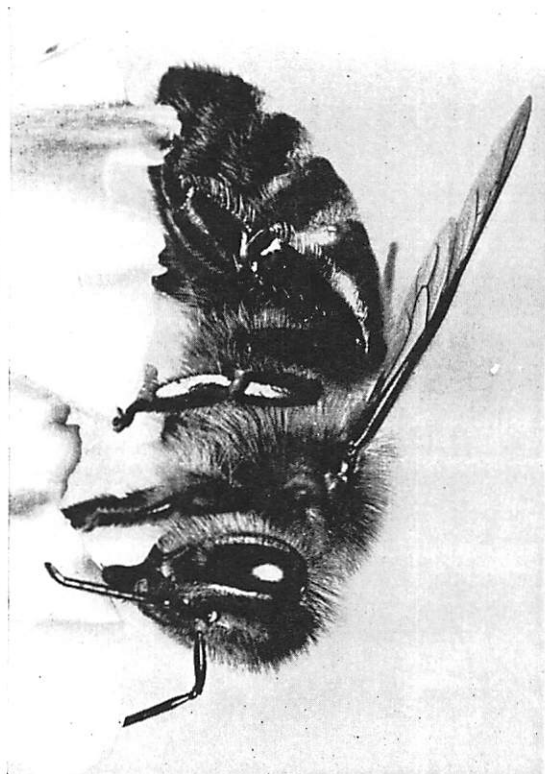
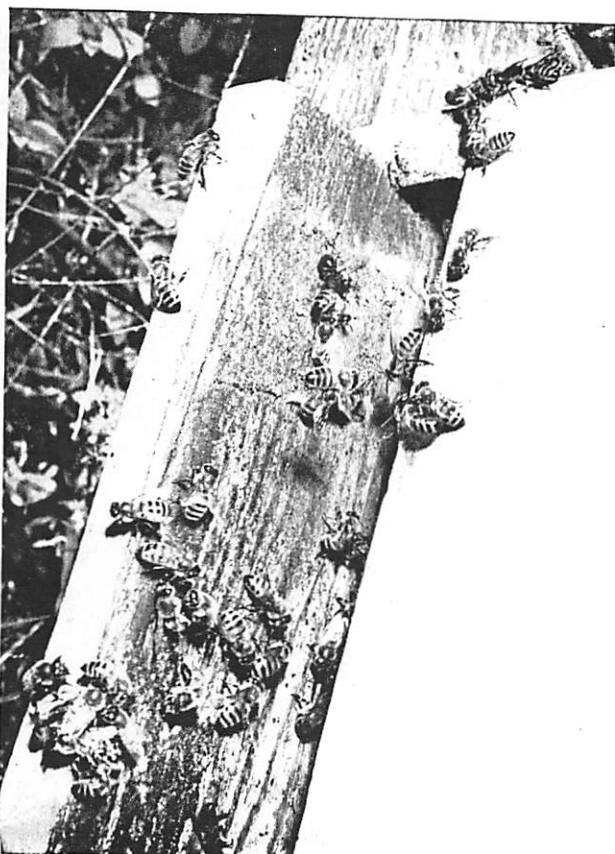


BEE

White larvae of the honeybee, in various stages of growth, are shown here inside the cells of the comb structure. They are still legless and must be supplied with food by the adults.

© Bernard L. Gluck

Below, worker bees drag aging drones and weeding or disabled workers out of the hive. One of the workers' many responsibilities is to maintain the productive efficiency of their caste.



When gathering pollen, a bee almost unfailingly goes to flowers of the same species. Seldom is more than one species of plant visited by an individual bee on any one trip.

© Bernard L. Gluck

Lower left: The drone or male bee has no sting and does no work besides mating with a new queen, whereupon he dies. Lower right: Worker guards are stationed at each entrance to the hive to chase away bees from other hives coming to steal honey. This guard personnel is constantly changing but always on the alert.



menaces the existence of the Colletidae. Now and then *Nomada*, another inquiline genus of the Anthophoridae, lays its eggs in the nests of *Eucera*, belonging to the same family, but predominantly the victims are members of the genus *Andrena*, type genus of the Andrenidae. The nests of Panurgidae and Halictidae are also occasionally invaded by *Nomada*.

Eupossidae.—These bees are confined to the tropics of the New World and are insects of singular beauty with brilliant metallic reflections and sometimes with abdominal hair bands of contrasted coloration. Remarkable in this family is the tongue (*glossa*), which frequently exceeds the length of the insect itself and, carried exposed below the abdomen, extends often well beyond the anal extremity. Another structural distinction



Fig. 7.—a, A male, natural size, of *Euplossa brailii*, showing the full extent of the whiplike tongue, retracted by a, a short-tongued species, *Colletes leucogaster* (female), and by b, c, d, e, f, the same species, showing the tongue extended, and the tip of the abdomen, and the tip of the abdomen extended further.

of these bees is the presence on the hind tibiae of the corbicula or pollen basket, which, alone among the solitary bees, Eupossidae share with the three exclusively social groups of bees—Bombidae, Meliponidae, and Apidae (here confined to the genus *Apis*). The last three are also characterized by their ability to produce wax. Apidae produce it ventrally on the abdomen, Meliponidae dorsally, and Bombidae both ventrally and dorsally. The wax is used in cell construction.

Bumblebees (Bombidae).—There are hundreds of kinds of bumblebees. Representatives of the family are found from Greenland and Alaska in the Far North to the southern tip of South America. Bumblebees are essentially a high altitude and high latitude fauna, however, and as a rule are absent from the tropical lowlands. In the Old World they are well represented in Europe and Asia and occur also along the Mediterranean fringe of North Africa, but the Sahara Desert has proved a barrier to their penetration southward. Australia has no native bumblebees. In New Zealand, originally also devoid of bumblebees, they are an essential part of the fauna since 1885. Until their introduction, red clover, which is largely dependent on certain bumblebees for its pollination, was not successfully grown. Red clover in turn is of importance as fodder for sheep, and thus a leading industry; sheep-raising of New Zealand owes its development in no small measure to the bumblebees.

Among the differences between bumblebee colonies on the one hand, and colonies of the honey-bee and of stingless bees on the other, is that, while the latter establish themselves by swarming, the bumblebee nest is usually founded by a single individual—the queen—who in addition to her activities in egg-laying engages initially also in foraging so as to provide sustenance for the brood that emerges from the eggs. The ability of the bumblebee queen not only to lay eggs but also to gather nectar and pollen after the manner

of the females of the solitary bees is due to the fact that structurally she is scarcely differentiated from her conspecific worker. She is provided with a corbicula (on which the moistened pollen load is carried home) comparable to that of the worker. The honeybee queen and the stingless bee queens, on the other hand, have undergone such extensive structural modification that they are no longer capable of field activities and in the economy of the hive are restricted to egg-laying.

Colonies of the honeybee and of the stingless bees are perennial and some of them survive over many years, with new broods of workers taking the place of those that have completed their rather brief life span. The queen continues to outlive successive broods of her worker daughters. On the other hand, in the case of the bumblebees (with the exception, it would seem of some species of the tropics) the colonies are annual affairs and, although the old queens are the longest span of life, she too, like the workers and the males, dies at the end of the annual cycle. The recently emerged young queens and copulations themselves, frequently in the soil, and in the spring each establishes independently a new nest, and in turn succumbs in the course of the year.

Bumblebees usually nest in or on the ground. The vacated nest of a small mammal—fieldmouse, chipmunk, vole, or the like—is apt to be favored. Here the overwintered young queen establishes her honey-pot and constructs the waxen egg cell that is to produce the first brood of workers. The queen, in addition to providing the food for her first brood, incubates this progeny, probably furnishing needed warmth.

Some bumblebees fashion one or more pockets of wax at the side of each mass of developing larvae and into these pockets drop their load of pollen on which the larvae feed. To such bees F. W. L. Sladen gave the name of pocket-makers. Other bumblebees store their provisions in cells detached from the bunches of larvae and these Sladen designated pollen-stores. Vacated cocoons are frequently used for the storage of honey but certain species construct waxen honey-pots as well. Sladen noted that the honey in these waxen pots was thin, while that in the cocoons was dense, and drew the conclusion that the former was for daily consumption, the latter reserved for periods of scarcity. As the first broods mature, new brood cells are constructed near the top of the cocoons and thus the colony expands.

One of the persistent myths that crops up from time to time in connection with bumblebees is that a particular bee, designated the trumpeter, sounds reveille for the hive by humming as she fans her wings from a vantage point on the nest. It is true that an individual bee or even several bees may vibrate their wings in this manner and give off sounds, but the phenomenon may occur at any time, whether morning or evening, and the humming is merely incidental to an act that is concerned with the ventilation of the nest. The act is not a single call to the colony to bestir itself but a substitute for an electric fan.

Even when a bumblebee queen after diligent search has taken possession of a nest site, her reign may be disrupted. Intruding queens sometimes kill and replace the legitimate founder of a colony. Otto Emil Plath found on several occasions as many as eight or ten dead queens in nests

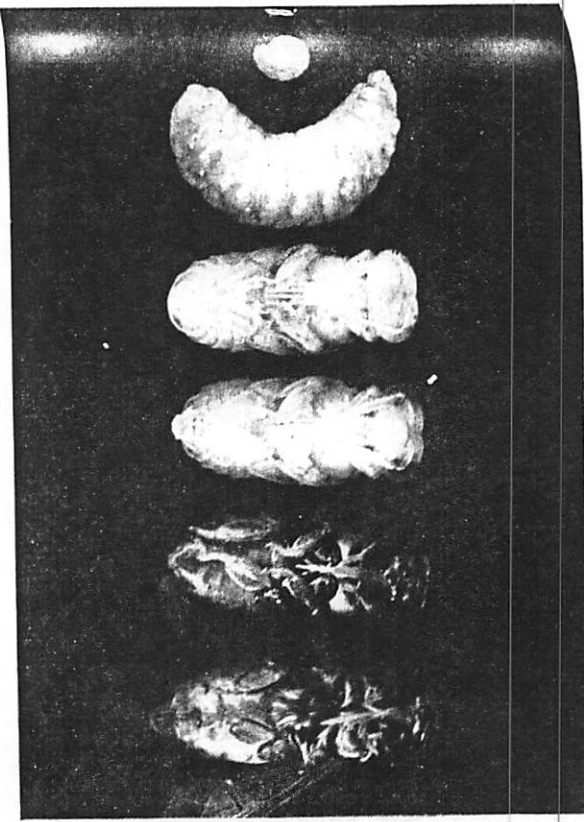
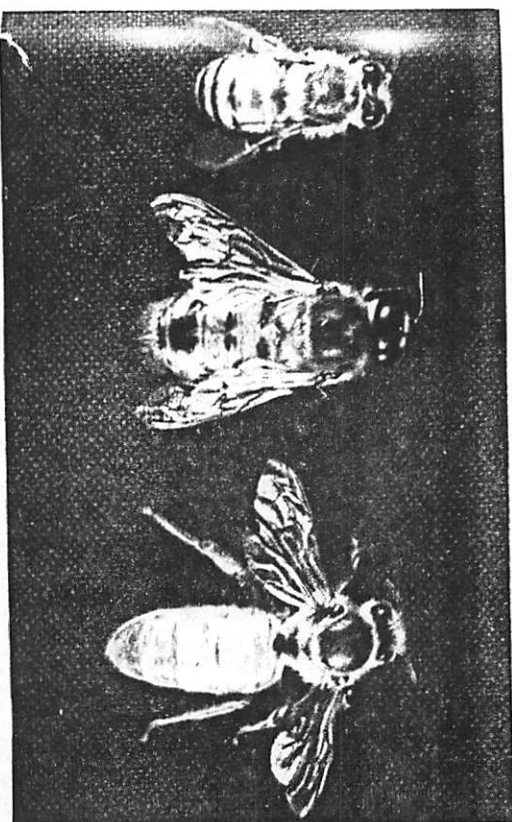


Fig. 8.—The life cycle of the honeybee. Left to right: (1) Egg, (2) young larva, (3) mature larva, (4) a white pupa showing the outline of adult legs and antennae, (5) a pupa in which the adult has become fully colored and is ready to emerge, and (6) an adult worker with fully-formed wings.

BEE

Fig. 9.—Photograph by Charles E. Dyer, from *Microscopic Study of Bees*, by Charles E. Dyer and Mary M. Dyer, 1951, D. Van Nostrand Company, Inc.



The three castes of the honeybee. Left to right: (1) Worker, (2) drone or male, and (3) queen. Note that the queen is the largest and has a slender body. The drone is more robust, and the worker is the smallest of the three, and provisionally the busiest. The queen is the smallest of the three, and provisionally the busiest.

queen, of greater longevity than her progeny, shares the nest with her descendants, which, if of the worker caste, take over many of the household responsibilities in addition to foraging abroad. Though the workers of the honeybee and of the bumblebee are capable of laying eggs that develop into males and, in queenless colonies, will resort to such expedients, the queen is habitually the sole ovipositing member of the community. Instances of a social setup are found among the Halictidae and in the genus *Meloboris* of the Cerambycidae but the bees that particularly exemplify the social state are those belonging to the families Bombidae, Meliponidae, and Apidae. So closely related are the last three that Charles Duncan Michener, a penetrating student of the bees, has made all three of them, as well as the Euglossidae of solitary habit but of related structure, tribes of the subfamily Apinae.

Primitive Bees.—Let us first turn our attention to the solitary bees as above defined. The most primitive bees are those belonging to the family Prosopidae (Hyaleidae). As a general rule bees tend to be hairy but in the Prosopidae the body pubescence is of scanty development and a special apparatus for pollen-collecting is lacking. Also low in the scale of development are



Fig. 2.—a, Antenna cleaner (indicated by arrow) in the metasoma of the foreleg of a primitive bee (*Paracletes vespertina*, female). b, By running an antenna through this orifice, adherent obstructive particles are removed. c, Expanded and ornamented tarsal joint of the foreleg of a male of *Megachile latimanus*. d, The expanding joint in a male of *Megachile politus*. All of the same enlargement.

bees of the family Colletidae. These bees are much more hairy, but their affinity with Prosopidae is indicated by the structure of their tongue (glossa), which like that of Prosopidae is short and usually truncate or emarginate apically. Both of these groups have in common an interesting method of nest building. Most solitary bees use alien material for the construction of their cells but these primitive bees employ a secretion of their own, probably saliva, for the purpose. Both families are widely represented the world over. From Australia alone more than 100 species of *Prosopis* (*Hyaleas*) have been described. The Colletidae, too, are abundant and diversified in that continent but the type genus *Colletes*, well represented elsewhere, does not occur there. Among the interesting Neotropical representatives of the family are the genera *Campichneumon* and *Ptilochloa*.

Halictidae and Andrenidae.—Halictidae are for the most part small bees or bees of intermediate length but many of them—especially those belonging to the genera *Halictus*, *Agrochloa*, *Agrochloa*, and *Agrochloa*—more than compensate through their brilliant metallic green coloration for relative unpretentiousness of size. Most bees are diurnal, collecting pollen and nectar while the sun is up, but among Halictidae is a genus, of the New World tropics, *Megachile*, that makes its floral visits at night. Halictidae, like some

Meliponidae, are given to lapping perspiration and in consequence have been given the name of "sweat bees." Halictidae are an abundant and diversified group and are found in all of the continents. Species occur also in the Arctic Circle as well as in southern Chile and Tasmania. Most Halictidae—and the same applies to Andrenidae—nest in the ground. In some instances the tunnels are branched in other cases the cells are arranged along a single main passageway. *Andrena* is a large mainly Holarctic genus.

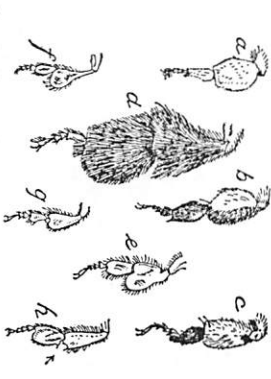


Fig. 3.—Contrasts in the shape of the hind tibiae and their equipment of hairs and also of the metatarsi and small tarsal joints. It is on the hind legs that these bees bear to their nest the pollen load. a, *Halictus confusus* (female, pollen-laden). b, *Andrena* (female). c, *Andrena* (female). d, *Andrena* (female). e, *Andrena* (female). f, *Andrena* (female). g, *Andrena* (female). h, *Andrena* (female). i, *Andrena* (female). j, *Andrena* (female). k, *Andrena* (female). l, *Andrena* (female). m, *Andrena* (female). n, *Andrena* (female). o, *Andrena* (female). p, *Andrena* (female). q, *Andrena* (female). r, *Andrena* (female). s, *Andrena* (female). t, *Andrena* (female). u, *Andrena* (female). v, *Andrena* (female). w, *Andrena* (female). x, *Andrena* (female). y, *Andrena* (female). z, *Andrena* (female).

Carpenter Bees.—The small carpenter bees (Cerambycidae) and the large carpenter bees (Xylocopidae) share certain structural characteristics. Both groups tunnel in wood to establish their nests. Cerambycidae choose as their nest sites sumac, raspberry, and other *Rubus* plants into the pith of which they tunnel. Xylocopidae prefer wood of more solid substance and sometimes inflict damage on wooden structures erected by man. Bees of the genus *Corymbus* spend the winter in small communal assemblies consisting of both males and females and it has been claimed that the males assist in the preparation of the winter quarters—one of the very few instances among the bees where the male bee has allegedly a role other than fertilization of the female. *Corymbus* is the only genus of small carpenter bees in North America but additional genera occur, especially in Africa and Australia. The large carpenter bees inhabit both hemispheres but favor the warmer regions. Rather striking sexual dimorphism is exemplified in some of the Xylocopidae, the females being black, the males tawny. A peculiar structural characteristic known as the "unit pocket" is located in the first abdominal segment of the female of certain *Megachile* of Africa and Oriental Asia. It serves as a place of assembly for numbers of female mates of the genus *Dichocryptus*.

Various Families.—Fidelidae is an African family of somewhat disputed affiliation. V. P. Popov placed them among the lower families of bees. Their mouth parts and thoracic configuration induced Charles Duncan Michener to place them among the higher bees. Heinrich Friese and Hans Bischoff pointed out that *Fiducia* is

somewhat intermediate in pollen-collecting habits between the Megachilidae and the leg-gathering bees, although structurally it belongs in the latter group. Melitidae occur in various parts of the world but only three genera—*Melitta*, *Aspilota*, and *Macropis*—are established in North America. Panurgidae, represented in Africa, are present in the other continents. A tribe, to which Philip Himmer Timberlake has assigned an intensive study. Also a member of this tribe is the nocturnal bee that I. D. A. Cockerell called *Acerophanax*, which, like the night-flying *Megachile*, nocturnal Melitidae wasps, and the tribe of the Vespidae, is equipped with unusually large ocelli, organs which are present in bees near the top of the head in addition to larger compound eyes on the sides of the head.



Fig. 4.—Male bees usually have longer antennae than the females of their species. a, *Andrena* (male). b, *Andrena* (female). c, *Andrena* (male). d, *Andrena* (female). e, *Andrena* (male). f, *Andrena* (female). g, *Andrena* (male). h, *Andrena* (female). i, *Andrena* (male). j, *Andrena* (female). k, *Andrena* (male). l, *Andrena* (female). m, *Andrena* (male). n, *Andrena* (female). o, *Andrena* (male). p, *Andrena* (female). q, *Andrena* (male). r, *Andrena* (female). s, *Andrena* (male). t, *Andrena* (female). u, *Andrena* (male). v, *Andrena* (female). w, *Andrena* (male). x, *Andrena* (female). y, *Andrena* (male). z, *Andrena* (female).

Bees of this family have their mandibles placed toward the posterior margin of the eye. Anthophoridae are frequently ground-nesting and many species of *Anthophora* both in the Old World and the New extend outward their nest entrance in an embankment by constructing a wide, curving chimneylike projection. Somewhat movable structures are fashioned by wasps of the genus *Odynerus*.

Leaf-cutters and Their Relatives (Megachilidae).—With the exception of the Prosopidae, all of the families thus far considered have the main carry their load of pollen on the hind legs. Bees adapted to this method of transportation are sometimes referred to as *megachilids* (Megachilidae). In contrast, a very interesting family, Megachilidae, collect pollen on the hind legs but on the underside of the tibia, which is provided with a ventral brush of retaining the pollen grains. Bees, thus adapted, are sometimes referred to as *Gastrophys* (abdomen-gatherers). Megachilidae are a large group. The type genus *Megachile*, alone

members considerably more than a thousand different forms the world over. Most of the com-

stituent species construct their thimble-shaped cells of leaf particles—oval pieces for the sides and round ones to plug up the top of a cell. These the female bee cuts with great precision with her mandibles as she sits astride a leaf. Young leaves are favored and a plant that is used as a quarry can at once be recognized by the geometric excisions made along the margins of its leaves. More rarely the petals of flowers are used and still more rarely birchbark. Members of the genus *Osmia*—bees of metallic blue appearance—often separate the cells of their nest with partitions of clay or of chewed-up leaves or material gathered from the earth-dwelling forms. Some *Osmia*, especially the earth-dwelling forms, line their cells with petals of flowers. Poppies are favored by the European *Osmia lunata* and *Osmia papaveris*. The latter derives its scientific name from that partially. Several species select for their nest the empty shells of land snails. Among the most interesting of these is *Osmia lilcolor*, which, as a completing technique of nest-making, covers the hollow shell containing her prospective brood with a scaffolding of pine needles, to which are added particles of moss and the like until the nest is well concealed. Rostrous cells are constructed by *Dianthidium* while members of the closely related genus *Anthidium* use woolly plant material that they scrape, with mandibles, into a pulp, which they then use to construct simple, supplied with teeth, from suitable plants. To the Megachilidae belong also the mason bees (*Chalcididae*).

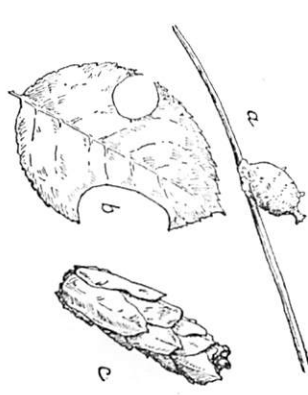


Fig. 5.—a, A section of a leaf showing the work of a leaf-cutting bee. b, A section of a leaf showing the work of a leaf-cutting bee. c, A section of a leaf showing the work of a leaf-cutting bee. d, A section of a leaf showing the work of a leaf-cutting bee. e, A section of a leaf showing the work of a leaf-cutting bee. f, A section of a leaf showing the work of a leaf-cutting bee. g, A section of a leaf showing the work of a leaf-cutting bee. h, A section of a leaf showing the work of a leaf-cutting bee. i, A section of a leaf showing the work of a leaf-cutting bee. j, A section of a leaf showing the work of a leaf-cutting bee. k, A section of a leaf showing the work of a leaf-cutting bee. l, A section of a leaf showing the work of a leaf-cutting bee. m, A section of a leaf showing the work of a leaf-cutting bee. n, A section of a leaf showing the work of a leaf-cutting bee. o, A section of a leaf showing the work of a leaf-cutting bee. p, A section of a leaf showing the work of a leaf-cutting bee. q, A section of a leaf showing the work of a leaf-cutting bee. r, A section of a leaf showing the work of a leaf-cutting bee. s, A section of a leaf showing the work of a leaf-cutting bee. t, A section of a leaf showing the work of a leaf-cutting bee. u, A section of a leaf showing the work of a leaf-cutting bee. v, A section of a leaf showing the work of a leaf-cutting bee. w, A section of a leaf showing the work of a leaf-cutting bee. x, A section of a leaf showing the work of a leaf-cutting bee. y, A section of a leaf showing the work of a leaf-cutting bee. z, A section of a leaf showing the work of a leaf-cutting bee.

Inguine Bees.—Bees are beset by many enemies, some of them members of their own suborder. There are many genera of bees that structurally ill-provided for foraging, eschew industry and instead live at the expense of a host species by having their eggs on the provisions intended for the offspring of the host. These intruders, whose habits are reminiscent of those of the European cuckoo and the American cowbird, are in some cases relatives of the bees they impose upon. Thus among the Megachilidae, just considered, there are genera like *Corymbus*, *Libinia*, *Stelis*, *Chelidonia*, and others that victimize industrious genera of their family. Similarly *Trypoxys* oviposits in nests of *Melissodes* although both aggressor and victim have been placed in the same family (Anthophoridae). In contrast, *Epeolus*, a close relative of *Trypoxys*,

ment for Bedford, Mid Division, South Division, and the borough of Luton. Pop. (1951) county, 311,844.

BEDIER, béd'yer, Charles Marie Joseph, French author and medieval scholar; b. Paris, June 28, 1864; d. Grand Serre, in the department of Drome, Aug. 30, 1938. Considered one of the leading authorities of French medieval literature, Bedier was responsible for a new theory of the development of the chansons de geste of the Middle Ages. Their growth, he said, was a development of tales fostered along the great pilgrim routes in 11th century France. His criticism was based entirely upon extant manuscripts, not, as before, upon critical imagination and allowance for error in manuscripts. His *La Formation des légendes épiques* (1908-1913) first set forth his theories of the development of medieval French literature as against the old theories of evolutionary development.

BEDIVERE, béd'vēr, Sir, in Arthurian legend, one of King Arthur's most trusted knights. It was Sir Bedivere who cast the sword Excalibur into the lake and carried the dying Arthur to the vessel in which he was borne away to Avalon.

BEDLAM, béd'lām, a corruption of Bethlehem, as applied to Saint Mary of Bethlehem, the name of a religious foundation, granted in 1247 by Henry VIII to the corporation of London, and by them applied as early as 1402 to the purpose of a hospital for the insane. The place was originally within the city boundaries, but in 1815, a new building was erected in Lambeth, on the right side of the Thames, and was vulgarly called Bedlam. The patients, who had been discharged partially cured and went about begging, were called bedlam beggars or Tom o' Bedlams. The word *bedlam* has become a colloquialism to describe any place of noise and confusion.

BEDLINGTON TERRIERS. See TERRIER.

BEDLINGTONSHIRE, béd'līng-tūn-shīr, an urban district, England, in Northumberland, on the river Tyne, five miles southeast of St. Peter. It is an important coal-mining center and has brick works and agricultural development. It is also famous for its terriers. The Church of St. Cuthbert, of Norman architecture, is a landmark and was one of the traditional resting places of the body of the saint. Pop. (1951) 28,836.

BEDLOES, béd'loz, or LIBERTY ISLAND, an island in New York harbor. It was acquired by New York in 1758 and was ceded to the United States government around 1800. It became the site of Fort Wood in 1841, and is now the location of Frederic A. Bartholdi's colossal statue of *Liberty Enlightening the World*, better known to Americans as the Statue of Liberty, presented by France to the United States in 1885. The island became a national monument in 1937.

BEDMAR, bād-mār', Maqarūs de (Al-Farisi; b. 1572; Otricoli, Aug. 2, 1653). He was sent in 1607 by Philip III as ambassador to Ven-

ice, and rendered himself famous by the conspiracy against the Venetian Republic in 1608 in which Abbe de Saint-Réal has so well described in his *Conjuration des Espagnols contre Venise* (1604). Notwithstanding the circumstances with which the details are given by Saint-Réal, the very existence of the conspiracy is still considered by many a very difficult historical problem. The probability is that the conspiracy was real, but that the Venetian Senate, satisfied with having discovered it and not willing to deal altogether with Spain, did not think it advisable to give it much publicity. It forms the subject of Thomas Otway's tragedy, *Venice Preserved* (1682). Bedmar was obliged to save himself by flight to avoid the fury of the populace but he did not lose the favor either of his own sovereign or of the pope. By the former he was appointed president of the Council of Flanders (1622), and he received a cardinal's hat from the latter in the same year.

BEDOUN, béd'ōn-in or béd'ōn-ān (Arab. *bédūn*; dweller in the desert), the name given to the nomadic Arab, as distinguished from the coastal or residential Arab, called *Felāhin*. The Bedouins inhabit the deserts of Arabia, northern Africa, and Syria, where they live in tents made of goat's hair, and exist almost solely on the produce of their herds of camels, sheep, and goats. Their life is spent in a constant round of grazing quarters for their flocks.

A fierce and warlike people, Bedouins retain the Arabic features and customs in their present form. Lack of communications with the outside, more civilized world has made them an independent and proud people, scornful of modern ways. They are of a cheerful and courteous temperament, especially when entertaining guests under their own roof, but to make an enemy of one is to expect cruelty and treachery at any moment. Great importance is attached to a family's genealogy and strict rules are set to prevent one of the purest ancestry from marrying one of dubious ancestry.

Horses and camels are raised in great numbers, although the horse is used only for riding and racing, and wealth is measured by the number of camels one has. This, in turn, depends on the endurance and speed of the pure bred horses when riding other tribes for more camels. The Bedouins are Mohammedans, though of a freely simplified and somewhat pagan sort. The head of the tribe is called the *sheik* and, although primogeniture is not generally followed, the rule usually stays in a single family. See also *Arabi—The People*.

BEDSORE (also *Pressure Sore*, *Decubitus Ulceri*), a local necrosis of the skin and subcutaneous tissue, generally occurring on the posterior surface of a portion of the body which has been subjected to pressure. Long-continued pressure from spinals, plaster dressings and the injudicious use of hot-water bottles in cases of unconscious or paralyzed patients are also occasionally responsible. Bedsore are usually seen in the skin over bony prominences such as the pelvis, sacrum, crest of the thigh, the prominences of the ankle, and the heel. Pressure which excludes the arterial blood supply to the tissue will lead, if continued, to necrosis and gangrene. Early signs of a developing bed sore in a nonparalyzed patient are burning sensations and local pain. If the case is seen

and reddening of the skin, only has developed, removal of the pressure and gentle massage will prevent necrosis. The use of alcohol and salicylic powder is also useful. If cared for early, a healing ulcer will usually heal. In old cases, a sloughing and secondary infection, a necrotic may develop.

HAROLD WELLINGTON JONES, M.D., *Chief Director, Army Medical Library; Editor, Bulletin's "New Gould Medical Dictionary."*

BEDSTRAW or GALIUM, a genus of about 220 annual or perennial herbs with four-lobed stems, of the family Rubiaceae, natives of the temperate climates in the northern hemisphere. The species are often attractive by their regular whorls of leaves and their blossoms, which in some species are used by artists to add lightness to bouquets of heavy flowers and to cover rockeries. The two species most cultivated for this purpose are *millifolius*, sometimes wrongly called "baby's breath," and *G. boreale*. Yellow bedstraw (*G. flavum*), a species with yellow flowers, yields a red dye when boiled in alum solutions, and the roots yield a red dye, said to rival madder as a wool dye. For this use attempts at cultivation have been made in England. The plant is also used in curdling milk. This species, together with *G. tridatum* and *G. boreale*, when the bones and milk of animals that eat them in quantity. Goose grass or cleavers (*G. arvense*), a troublesome weed common to Europe, Asia and America, yields a seed sometimes used as a substitute for coffee. It is used for the hooked pickles of its stems, twigs and leaves. In China *G. hibrissum* is valued for its farinaceous tubers. Some species, for instance, *G. mollino* and *G. rigidum*, have been tried in cases of epilepsy and others in chancreous disorders.

BEE. All bees belong to the suborder Apicula, which in turn is a division of the order Hymenoptera. Other well known insects placed in different suborders of the Hymenoptera are the sawflies and the so-called ichneumon flies (both of which, notwithstanding their popular name, are wasps), the ants, the social wasps that build paper nests, the gall-making wasps, the sphecoid wasps, and others.

The closest relatives of the bees within this assemblage are the sphecoid wasps. Unlike the sphecoid wasps, which provision their nests with insects or, in some instances, with spiders, bees are partial to pollen and nectar (or nectar re-arranged as honey). The structural modifications that differentiate the bees as a group from the sphecoid wasps as a group are associated with this divergence in food habits. The bees are provided with branched hairs for the retention of pollen during their floral visits whereas similar hairs suffice the sphecoid wasps in the pursuit of their prey. In the bee the metathorax, particularly the mediotarsus of the third pair of legs, is widened. Thus a larger surface is provided for the essential brushes on the inner face of the legs. Tongues of bees are adapted for sucking nectar, and the walls of the distensible honey-stomach are provided with muscles for regurgitating nectar.

Abundance of Species and Subspecies—The list of bees published in the *Catalogus Hymenopterarum*, vol. 10 (1896) of Karl Wilhelm von Dalla Torre included the names of and bibliographical references to more than 6,000 kinds. In the subsequent half century a single melittologist, albeit an exceptionally productive one, Theodore Dru Alison Cockerell, described more than 5,000 additional new forms. Many other melittologists in lesser degree have extended the known alphabets of the world and annually there are accretions to the total of species. In view of these evidences of an extensive bee fauna, the estimate that Heinrich Friese—himself a describer of many species—made when he placed the different kinds of bees at 20,000 is probably to be regarded as conservative.

Contrasts in Size—In the vast assemblage that the bees constitute there are differences of structure, of coloration, and of size. *Trigona (Hypotrigona) duckei* of the American tropics, often referred to as the smallest of the bees, is so tiny that the species was described from a specimen that lodged in the eye of an entomologist, and the describer expressed doubt whether a collecting net was fine enough to hold it. This dwarf, only about 2 mm. in length, has competitors in minuteness among the members of the Australian genus *Trochilid*. At the other extreme are such giants of the bee world as *Megachile pharaonis*, 38 mm. long, from Balaban (Bachman), East Indies, the huge queen of a South American humblebee, *Bombus dalmanii*, which sometimes has a length of more than 50 mm., and the portly members of *Xylocopa* or large carpenter bees.

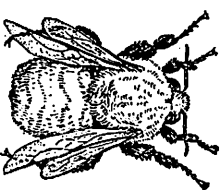


FIG. 1.—The dwarf species of the bees, *Trigona duckei* (worker), compared with a gigantic humblebee queen (*Bombus dalmanii*), both natural size.

Solitary Bees and Social—It is not unusual to think of bees as perpetually social because the best known bees fall within that category. Yet it has been estimated by William Morton Wheeler that only about five per cent of the species live in colonies. All of the rest are solitary in habit. In the case of the solitary bees a single fertilized female constructs her nest independently, cell by cell, stocking each cell with pollen (sometimes mixed with nectar) of her own gathering, lays an egg on this provision, seals the cell thus supplied before proceeding to the construction of the next cell, and finally after the nest is completed closes it and flies off never to return. The larvae that emerge from the eggs, one to a cell, go through their successive instars or months, pupate, and finally emerge as adults to repeat, if they are females, the same life history as their mother. In this scheme of things the parent never becomes acquainted with her offspring. By way of contrast, in the social bees the